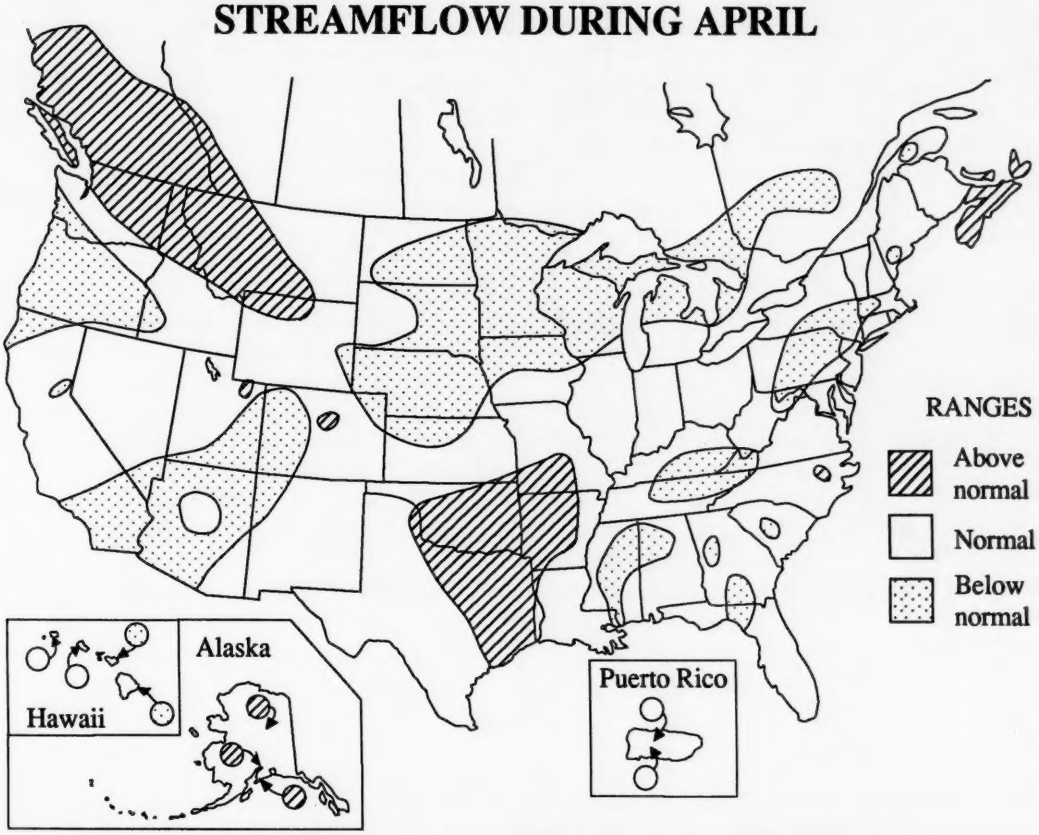
National Water Conditions

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

APRIL 1990

STREAMFLOW DURING APRIL



Streamflow was in the normal to above-normal range at 65 percent of the index stations in southern Canada, the United States, and Puerto Rico during April. Below-normal range streamflow occurred in 24 percent of the area of southern Canada and the conterminous United States during April compared with 20 percent during March. Total flow for the index stations in the conterminous United States and southern Canada was 9 percent below median.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged 2 percent above median and in the normal range during April.

Monthend index reservoir contents were in the below-average range at 32 of 100 reporting sites, compared with 34 of 100 during March. Contents were in the above-average range at 39 reservoirs compared with 42 last month. Lake Tahoe (California-Nevada) had 9 percent usable storage at the end of the month which breaks the 4-month trend of no usable storage, while San Carlos (Arizona) had only 5 percent of normal maximum contents for the second consecutive month.

Mean April elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) were in the below-normal range on Lake Superior, and in the normal range on Lake Huron, Lake Erie, and Lake Ontario.

Utah's Great Salt Lake remained at 4,204.70 feet above National Geodetic Vertical Datum of 1929 April 1-30.

SURFACE-WATER CONDITIONS DURING APRIL 1990

Streamflow was in the normal to above-normal range at 65 percent of the index stations in southern Canada, the United States, and Puerto Rico during April, compared with 70 percent of stations in those ranges during March, and 76 percent of stations in those ranges during April 1989. Below-normal range streamflow occurred in 24 percent of the area of southern Canada and the conterminous United States during April compared with 20 percent during March and 14 percent during April 1989. Total April 1990 flow of 2,672,600 cubic feet per second (cfs) for the index stations in the conterminous United States and southern Canada was 9 percent below median after a 4 percent decrease in streamflow from March to April, and 11 percent less than flow during April 1989.

Six new monthly highs (table on page 4) occurred at streamflow index stations during April compared with four new lows during March. The new highs were at stations in Nova Scotia, Montana, Oklahoma, and Alaska. Hydrographs for the index stations at which new extremes occurred are shown on page 5. A seventh hydrograph is for the Oconto River near Gillett, Wisconsin, where the monthly mean of 380 cfs was the second lowest of record (79 years) for the month.

The combined flow of the 3 largest rivers in the lower 48 States—Mississippi, St. Lawrence, and Columbia—averaged 1,425,600 cfs (1 percent above median and in the normal range) during April, 6 percent less than during March. Flow of all 3 rivers was in the normal range. During March, flow of the Mississippi River was in the above-normal range and flow of the St. Lawrence and Columbia rivers was in the normal range. Hydrographs for both the combined and individual flows of the "Big 3" are on page 6. Dissolved solids and water temperatures at five large river stations are also given on page 6. Flow data for the "Big 3" and 42 other large rivers are given in the Flow of Large Rivers table on page 7.

Monthend index reservoir contents for April 1990 were in the below-average range (below the monthend average for the period of record by more than 5 percent of normal maximum contents) at 32 of 100 reporting sites, compared with 34 of 100 during March, including most reservoirs in Nebraska, the Dakotas, Idaho, California, Nevada and Arizona. Contents were in the above-average range at 39 reservoirs (compared with 42 last month), including most reservoirs in Maine, New Hampshire, New Jersey, the Tennessee Valley, Minnesota, Oklahoma, Texas, and Washington. Reservoirs with contents in the below-average range and significantly lower than last year (with normal maximum contents of at least 1,000,000 acre-feet) were: International Amistad, International Falcon, and Lake Travis, Texas; Lake McConaughy, Nebraska; Fort Peck, Montana; Boise River and associated reservoirs, Idaho; Upper Snake River and associated reservoirs, Idaho-Wyoming; the

(Continued on page 4)

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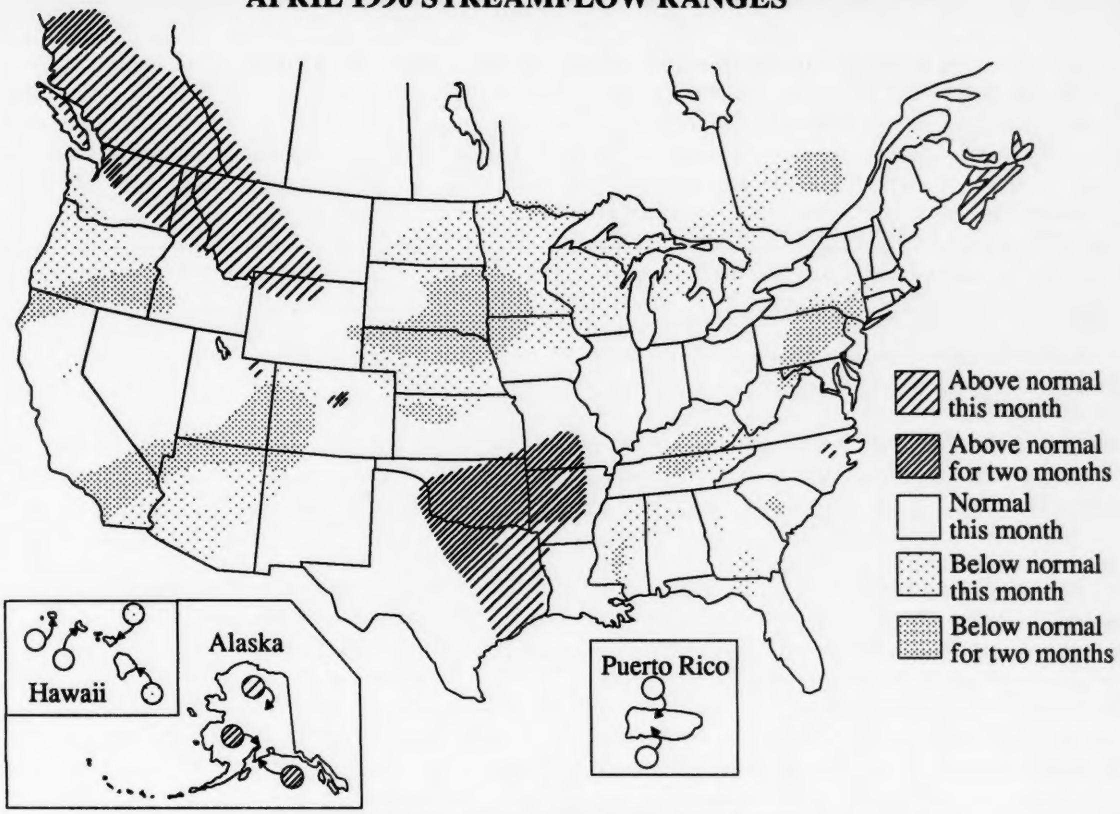
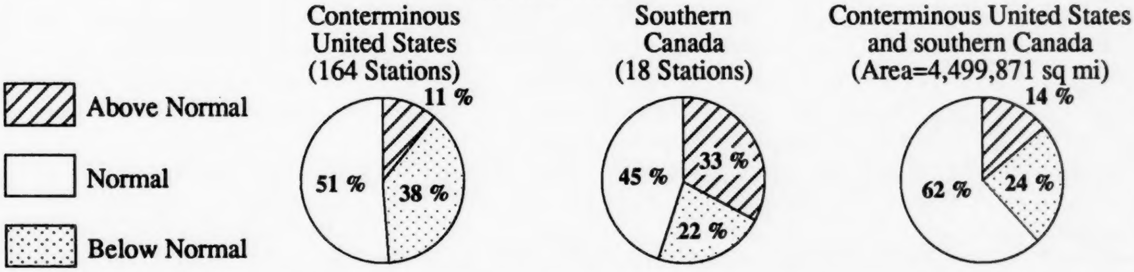
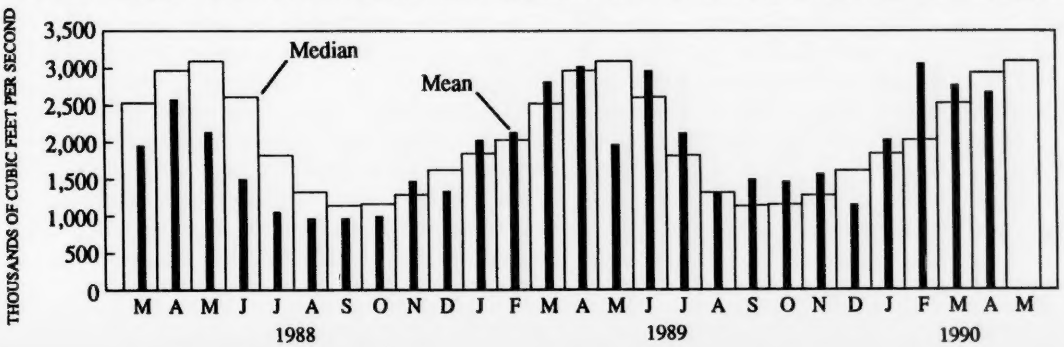
APRIL 1990 STREAMFLOW RANGES



SUMMARY OF APRIL 1990 STREAMFLOW FLOW RANGES



COMPARISON OF TOTAL MONTHLY MEANS WITH TOTAL MONTHLY MEDIANS



NEW HIGHS DURING APRIL 1990 AT STREAMFLOW INDEX STATIONS

Station number	Stream and place of determination	Drainage area (square miles)	Previous April highs (period of record)			April 1990			
			Years of record	Monthly mean in cfs (year)	Daily mean in cfs (year)	Monthly mean in cfs	Percent of median	Daily mean in cfs	Day
01980300	Northeast Margaree River at Margaree Valley, Nova Scotia	142	72	1,924 (1988)	12,100 (1962)	1,977	232	7,133	5
06191500	Yellowstone River at Corwin Springs, Montana	2,623	83	2,981 (1946)	7,660 (1952)	3,470	258	6,920	22
07331000	Washita River near Dickson, Oklahoma	7,202	61	11,486 (1942)	36,000 (1942)	15,700	1,677	68,400	27
15290000	Little Susitna River near Palmer, Alaska	61.9	41	38.5 (1989)	120 (1989)	74.2	345	180	30
15514000	Chena River at Fairbanks, Alaska	1,980	41	755 (1965)	6,000 (1979)	887	245	2,700	30
15515500	Tanana River at Nenana, Alaska	25,600	27	10,400 (1989)	30,000 (1983)	16,290	210	37,000	30

Pathfinder and associated reservoirs, Wyoming; Colorado-Big Thompson Project, Colorado; Bear Lake, Idaho-Utah; and also Folsom Lake, Pine Flat Lake, Clair Engle Lake, Lake Berryessa and Shasta Lake, California. Lake Tahoe (California-Nevada) had 9 percent usable storage at the end of the month which breaks the 4-month trend of no usable storage, while San Carlos (Arizona) had only 5 percent of normal maximum contents for the second consecutive month. Graphs of contents for seven reservoirs are shown on page 8 with contents for the 100 reporting reservoirs given on page 9.

Streamflow conditions during April 1990 and April 1989 are shown by maps on page 10. There is about 73 percent more area in the below-normal range during April 1990 than during April 1989, but the total area in the above-normal range is about the same during both months. The locations of reservoirs with below-average contents at the end of April 1990 and April 1989 are also shown on the respective maps.

Mean April elevations at the four master gages on the Great Lakes (provisional National Ocean Service data) were in the below-normal range on Lake Superior, and in the normal range on Lake Huron, Lake Erie, and Lake Ontario. Levels declined from those for March only on Lake Superior. April 1990 levels ranged from 0.02 foot lower (Lake Superior) to 0.71 foot higher (Lake Ontario) than those for March. Monthly means have now been in the below-normal range for 7 months on Lake Superior. Monthly means have been in the normal range for 25 months on Lake Erie, 12 months on Lake Ontario, and 2 months on Lake Huron. April 1990 levels ranged from 0.93 feet higher (Lake Ontario) to 0.73 foot lower (Lake Superior) than those for April 1989. Stage hydrographs for the master gages on Lake Superior, Lake Huron, Lake Erie, and Lake Ontario are on page 11.

Utah's Great Salt Lake (graph on page 11) remained at 4,204.70 feet above National Geodetic Vertical Datum of 1929 April 1-30. The lake which declined 2.40 feet from the seasonal high of April 1-15, 1989 has now risen 0.3 foot since January 1. Lake level is 1.95 feet lower than at the end of April 1989, and 7.15 feet lower than the maximum of record which occurred in June 1986 and March-April 1987.

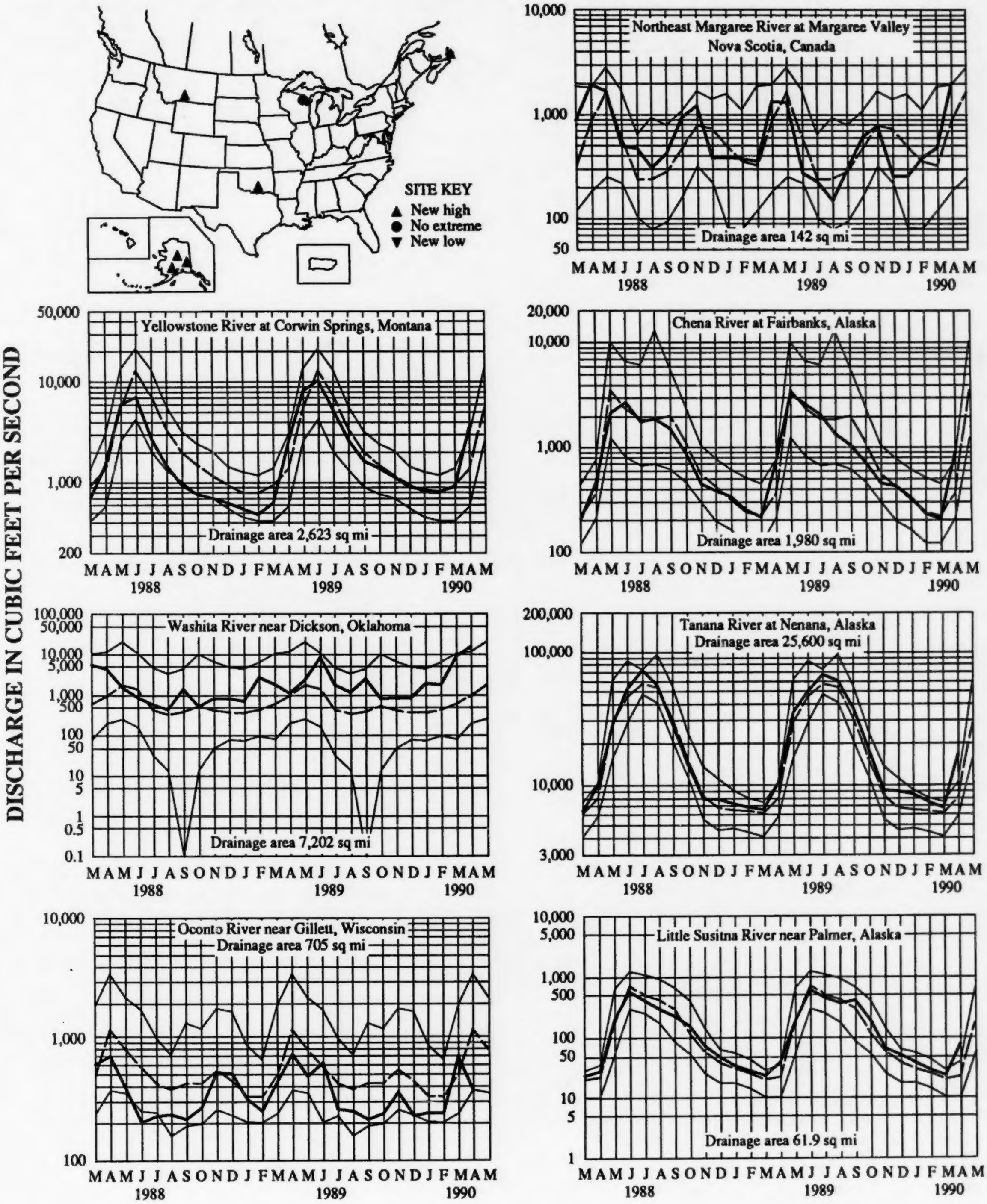
The Palmer Drought Severity Map for April 28, 1990 (page 14), shows that areas of extreme drought were all west of the Mississippi River except for the area in the southern part of Florida, although a serious drought also continues in northeastern Wisconsin and the upper peninsula of Michigan.

Precipitation in the United States during April 1990 (provisional National Weather Service map on page 16) was above-normal in three large irregularly shaped areas: the largest extending in a broad band from northwestern Washington and Idaho to southeastern Texas; another large area includes most of New England and extends from Maine to eastern North Carolina; and a third area includes most of Minnesota and parts of adjacent States. A large area of below-normal precipitation includes most of California and southern Arizona and New Mexico.

May - July 1990 outlook maps for both temperature and precipitation are on page 19. Precipitation is likely to be above median in a band from western Texas northeast to southern New York. Below median precipitation is likely in the area from Nevada and Utah through Wyoming, northeast to Montana and North Dakota, including parts of adjacent States.

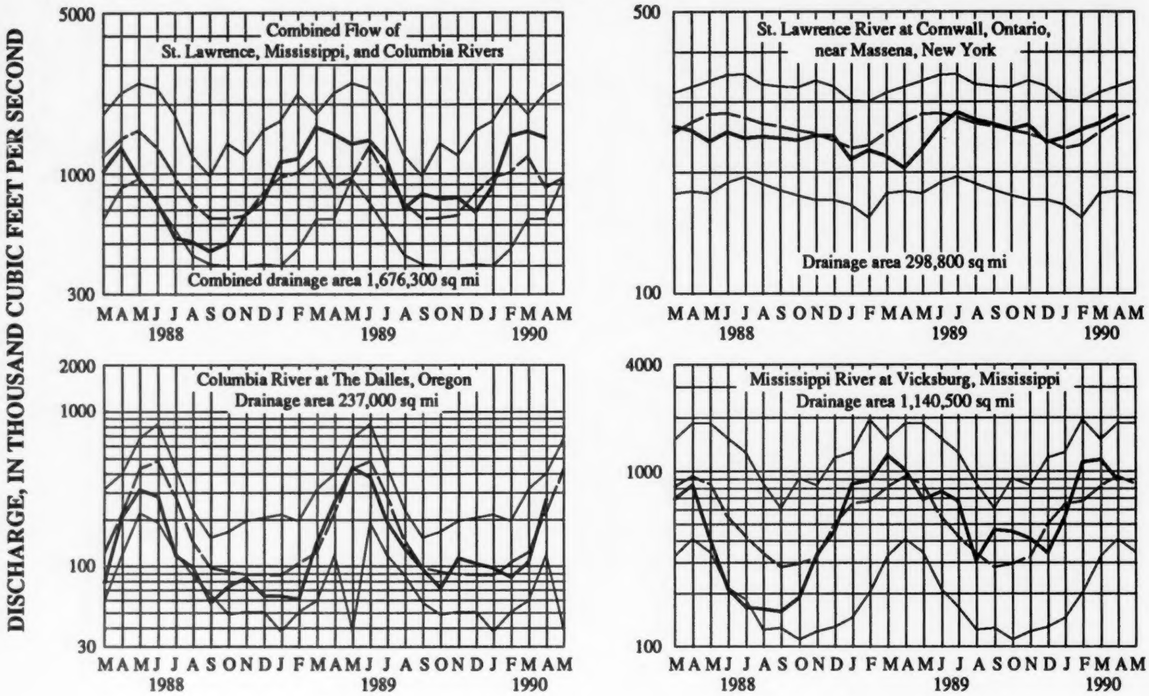
MONTHLY MEAN DISCHARGE OF SELECTED STREAMS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



HYDROGRAPHS FOR THE "BIG THREE" RIVERS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period.



Provisional data; subject to revision

DISSOLVED SOLIDS AND WATER TEMPERATURES, FOR APRIL 1990, AT DOWNSTREAM SITES ON FIVE LARGE RIVERS

Station number	Station name	April data of following calendar years	Stream discharge during month Mean (cfs)	Dissolved-solids concentration[a] Minimum (mg/L)	Dissolved-solids concentration[a] Maximum (mg/L)	Dissolved-solids discharge[a] Mean (tons per day)	Dissolved-solids discharge[a] Minimum (tons per day)	Dissolved-solids discharge[a] Maximum (tons per day)	Water temperature[b] Mean in °C	Water temperature[b] Minimum in °C	Water temperature[b] Maximum in °C
01463500	Delaware River at Trenton,	1990	14,990	80	102	3,588	2,001	6,201	11.0	7.0	20.0
	New Jersey, (Morrisville,	1945-89	21,710	46	124	4,187[d]	1,200	21,500	11.0	3.0	22.5
	Pennsylvania)	(Extreme yr)		(1962)	(1981)		(1985)	(1983)			
			[c]22,320								
07289000	Mississippi River at	1990	881,400	211	234	524,300	471,600	648,300	14.5	12.5	19.0
	Vicksburg, Mississippi	1976-89	988,700	150	288	543,700	180,000	1,030,000	15.5	7.0	22.5
		(Extreme yr)		(1985)	(1986)		(1981)	(1979)			
			[c]930,400								
03612500	Ohio River at lock and dam 53,	1990	293,000	173	231	......	117,000	248,000	...	10.5	14.5
	near Grand Chain, Illinois,	1955-89	426,900	117	282	......	22,400	462,000	...	5.0	19.0
	(streamflow station at Metropolis,	(Extreme yr)		(1957)	(1969)		(1976)	(1975)			
	Illinois)		[c]480,500								
06934500	Missouri River at Hermann,	1990	88,200	313	409	84,900	56,600	103,000	13.5	10.0	19.0
	Missouri. (60 miles west of	1976-89	127,500	157	504	113,300	41,400	270,000	13.5	6.0	22.5
	St. Louis, Missouri)	(Extreme yr)		(1979)	(1981)		(1977)	(1984)			
			[c]88,120								
14128910	Columbia River at Warrendale,	1990	201,000	92	101	53,100	40,000	64,100	10.5	8.5	12.0
	Oregon (streamflow station at	1976-89	197,900	85	128	56,500	22,300	96,100	9.0	6.5	12.5
	The Dalles, Oregon)	(Extreme yr)		(1976)	(1985, 1989)		(1977)	(1984)			
			[c]220,700								

[a]Dissolved -solids concentrations, when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 x °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1951-80, for comparison with data for current month.
[d]Mean for 6-year period (1984-89).

Provisional data; subject to revision

FLOW OF LARGE RIVERS DURING APRIL 1990

Station number	Stream and place of determination	Drainage area (square miles)	Average discharge through September 1985 (cubic feet per second)	April 1990: Monthly mean discharge (cubic feet per second)	Percent of median monthly discharge 1951–80	Change in discharge from previous month (percent)	Discharge near end of month: Cubic feet per second	Discharge near end of month: Million gallons per day	Date
01014000	St. John River below Fish River at Fort Kent, Maine ...	5,665	9,758	29,100	138	208	75,000	48,500	30
01318500	Hudson River at Hadley, New York	1,664	2,908	8,740	97	4	6,500	4,200	30
01357500	Mohawk River at Cohoes, New York	3,456	5,683	11,900	83	–21	4,200	2,710	30
01463500	Delaware River at Trenton, New Jersey	6,780	11,670	15,000	64	5	7,290	4,710	30
01570500	Susquehanna River at Harrisburg, Pennsylvania	24,100	34,340	46,000	63	41	24,100	15,600	30
01646500	Potomac River near Washington, District of Columbia..	11,560	[1]11,500	[1]12,800	68	60	......	......	...
02105500	Cape Fear River at William O. Huske Lock, near Tarheel, North Carolina.	4,852	5,002	7,200	116	51	......	......	...
02131000	Pee Dee River at Peedee, South Carolina	8,830	9,871	13,800	102	–28	3,770	2,440	30
02226000	Altamaha River at Doctortown, Georgia	13,600	13,730	20,400	85	–39	7,430	4,800	30
02320500	Suwannee River at Branford, Florida	7,880	6,986	6,350	63	–33	4,420	2,860	30
02358000	Apalachicola River at Chattahoochee, Florida	17,200	22,420	27,800	84	–58	19,200	12,400	30
02467000	Tombigbee River at Demopolis lock and dam, near Coatopa, Alabama.	15,385	23,520	20,000	42	–77	15,800	10,200	30
02489500	Pearl River near Bogalusa, Louisiana	6,573	9,880	9,220	53	–13	12,900	8,340	30
03049500	Allegheny River at Natrona, Pennsylvania	11,410	[1]19,580	[1]29,400	81	39	21,200	13,700	26
03085000	Monongahela River at Braddock, Pennsylvania	7,337	[1]12,480	[1]15,800	82	71	17,900	11,600	25
03193000	Kanawha River at Kanawha Falls, West Virginia	8,367	12,550	14,600	87	–23	9,420	6,090	29
03234500	Scioto River at Higby, Ohio	5,131	4,583	5,950	80	30	3,240	2,090	30
03294500	Ohio River at Louisville, Kentucky[2]	91,170	115,800	179,000	86	25	131,000	84,900	29
03377500	Wabash River at Mount Carmel, Illinois	28,635	27,660	42,500	84	–33	26,900	17,400	30
03469000	French Broad River below Douglas Dam, Tennessee	4,543	[1]6,739	7,200	64	–59	......	......	...
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wisconsin.[2]	6,010	4,238	2,860	41	–54	1,460	946	30
04264331	St. Lawrence River at Cornwall, Ontario, near Massena, New York.[3]	298,800	243,900	277,000	104	5	287,000	186,000	30
02NG001	St. Maurice River at Grand Mere, Quebec	16,300	24,910	24,700	56	374	103,000	66,400	30
05082500	Red River of the North at Grand Forks, North Dakota...	30,100	2,593	2,330	26	143	1,100	710	27
05133500	Rainy River at Manitou Rapids, Minnesota	19,400	12,920	8,000	48	23	7,900	5,110	26
05330000	Minnesota River near Jordan, Minnesota	16,200	3,680	994	14	14	966	624	26
05331000	Mississippi River at St. Paul, Minnesota	36,800	[1]11,020	8,100	33	–11	7,200	4,650	30
05365500	Chippewa River at Chippewa Falls, Wisconsin	5,650	5,149	3,360	32	–53	12,900	8,340	30
05407000	Wisconsin River at Muscoda, Wisconsin	10,400	8,710	5,980	38	–32	8,420	5,440	30
05446500	Rock River near Joslin, Illinois	9,549	6,080	7,080	70	–26	5,340	3,450	30
05474500	Mississippi River at Keokuk, Iowa	119,000	63,790	49,000	38	–47	66,600	43,000	30
06214500	Yellowstone River at Billings, Montana	11,795	7,056	6,860	172	167	8,520	5,510	30
06934500	Missouri River at Hermann, Missouri	524,200	80,880	88,200	100	–8	109,000	70,400	30
07289000	Mississippi River at Vicksburg, Mississippi[4]	1,140,500	584,000	881,000	95	–24	864,000	558,000	27
07331000	Washita River near Dickson, Oklahoma	7,202	1,402	15,700	1,680	77	21,800	14,100	29
08276500	Rio Grande below Taos Junction Bridge, near Taos, New Mexico.	9,730	742	450	87	–20	610	394	30
09315000	Green River at Green River, Utah	44,850	6,391	3,740	70	34	......	......	...
11425500	Sacramento River at Verona, California	21,251	19,430	15,100	77	24	......	......	...
13269000	Snake River at Weiser, Idaho	69,200	18,520	11,500	53	–4	16,800	10,900	30
13317000	Salmon River at White Bird, Idaho	13,550	11,390	14,100	137	227	14,500	9,370	30
13342500	Clearwater River at Spalding, Idaho	9,570	15,510	36,700	128	234	37,300	24,100	30
14105700	Columbia River at The Dalles, Oregon[5]	237,000	[1]193,500	[1]267,000	121	152	249,000	161,000	25
14191000	Willamette River at Salem, Oregon	7,280	[1]23,690	[1]19,200	66	–39	14,700	9,500	26
15515500	Tanana River at Nenana, Alaska	25,600	23,810	16,900	210	152	37,000	23,900	30
08MF005	Fraser River at Hope, British Columbia	83,800	96,250	106,000	169	207	166,000	107,000	30

[1]Adjusted.

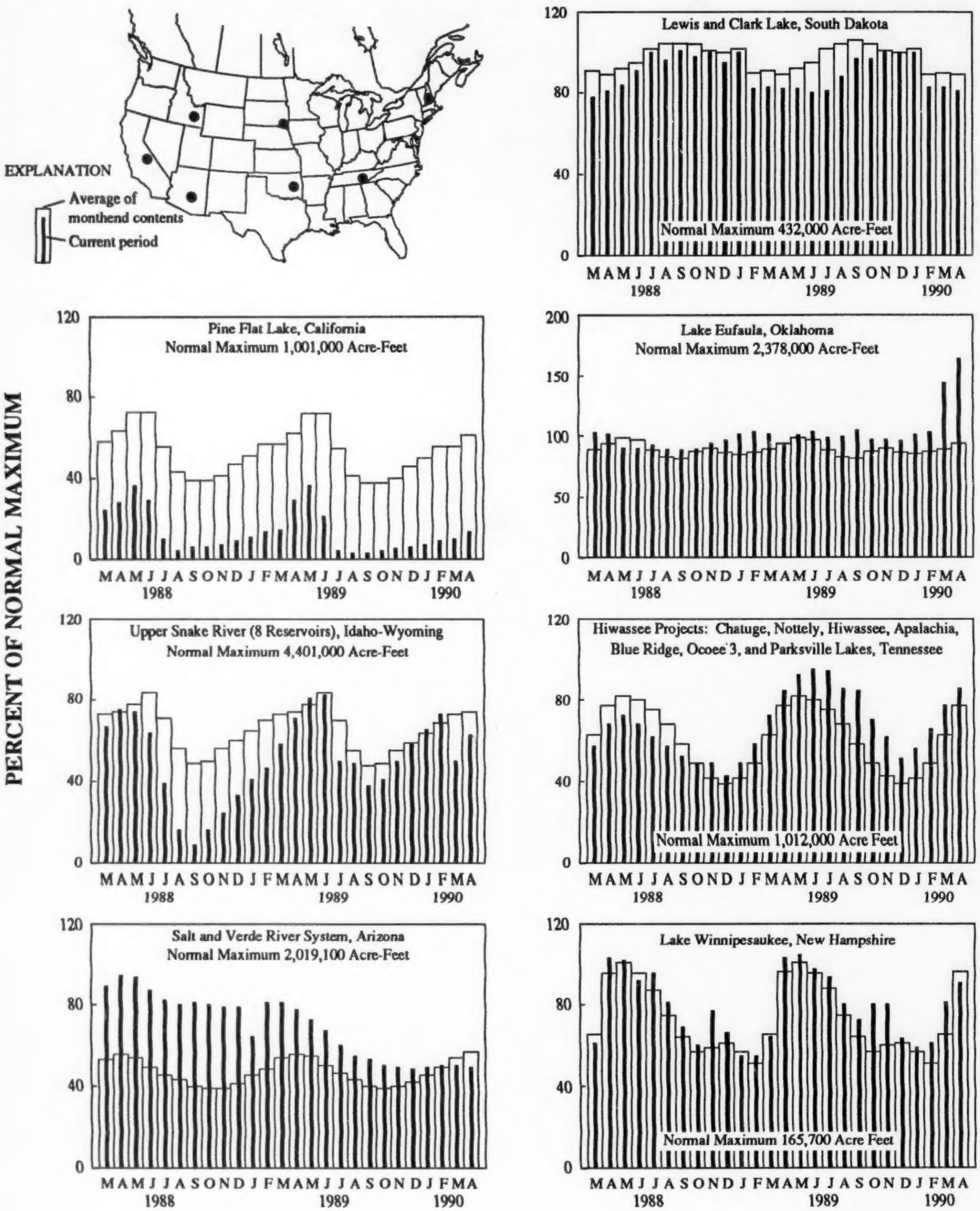
[2]Records furnished by Corps of Engineers.

[3]Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y., when adjusted for storage in Lake St. Lawrence.

[4]Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.

[5]Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS



USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF APRIL 1990

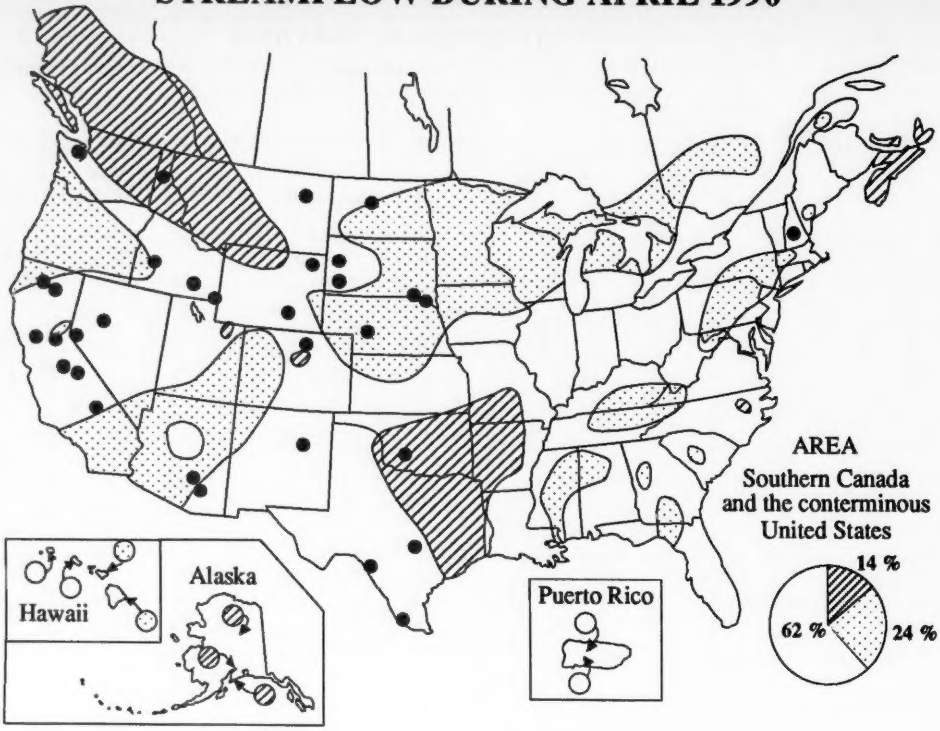
[Contents are expressed in percent of reservoir (system) capacity. The usable storage capacity of each reservoir (system) is shown in the column headed "Normal maximum"]

Reservoir Principal uses: F-Flood control I-Irrigation M-Municipal P-Power R-Recreation W-Industrial	Percent of normal maximum				
	End of April 1990	End of April 1989	Average for end of April	End of March 1990	Normal maximum (acre-feet)[a]
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	81	73	77	58	[b]226,300
QUEBEC					
Allard (P)	90	72	80	62	280,600
Gouin (P)	46	48	51	43	6,954,000
MAINE					
Seven Reservoir Systems (MP)	88	68	69	53	4,107,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	68	61	51	38	76,450
Lake Francis (FPR)	85	76	56	64	99,310
Lake Winnipesaukee (PR)	91	103	97	81	165,700
VERMONT					
Harriman (P)	75	86	78	73	116,200
Somerset (P)	84	76	74	77	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	93	86	88	92	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	100	91	90	81	786,700
Indian Lake (FMP)	94	96	91	90	103,300
New York City Reservoir System (MW)	100	71	100	99	1,680,000
NEW JERSEY					
Wanaque (M)	99	99	93	110	77,450
PENNSYLVANIA					
Allegheny (FPR)	49	49	45	37	1,180,000
Pymatuning (FMR)	98	98	101	89	188,000
Raystown Lake (FR)	68	67	60	67	761,900
Lake Wallenpaupack (PR)	77	75	78	64	157,800
MARYLAND					
Baltimore Municipal System (M)	93	84	93	91	261,900
NORTH CAROLINA					
Bridgewater (Lake James) (P)	90	95	92	97	288,800
Narrows (Badin Lake) (P)	95	92	100	98	128,900
High Rock Lake (P)	92	74	83	89	234,800
SOUTH CAROLINA					
Lake Murray (P)	88	91	83	89	1,614,000
Lakes Marion and Moultrie (P)	85	78	81	94	1,862,000
SOUTH CAROLINA-GEORGIA					
Strom Thurmond Lake (FP)	85	48	73	79	1,730,000
GEORGIA					
Burton (PR)	99	98	92	97	104,000
Sinclair (MPR)	86	87	91	90	214,000
Lake Sidney Lanier (FMPR)	66	51	62	69	1,686,000
ALABAMA					
Lake Martin (P)	98	98	95	95	1,375,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	67	69	61	59	2,293,000
Douglas Lake (FPR)	65	67	61	49	1,395,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	86	85	77	77	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	75	72	66	69	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	81	86	75	76	1,478,000
WISCONSIN					
Chippewa and Flambeau (PR)	93	89	72	84	365,000
Wisconsin River (21 Reservoirs) (PR)	67	66	70	58	399,000
MINNESOTA					
Mississippi River Headwater System (FMR)	41	39	31	35	1,640,000
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	58	62	82	59	22,700,000
SOUTH DAKOTA					
Angostura (I)	53	52	82	50	130,770
Belle Fourche (I)	50	59	71	44	185,200
Lake Francis Case (FIP)	79	80	86	75	4,589,000
Lake Oahe (FIP)	62	66	...	64	22,240,000
Lake Sharpe (FIP)	103	102	101	103	1,697,000
Lewis and Clark Lake (FIP)	81	82	89	83	432,000
NEBRASKA					
Lake McConaughy (IP)	70	79	79	71	1,948,000
OKLAHOMA					
Eufaula (FPR)	164	93	94	144	2,378,000
Keystone (FPR)	116	82	102	165	661,000
Tenkiller Ferry (FPR)	136	102	99	147	628,200
Lake Altus (FIMR)	38	95	57	37	133,000
Lake O'The Cherokees (FPR)	108	89	92	118	1,492,000
OKLAHOMA-TEXAS					
Lake Texoma (FMPRW)	181	89	92	119	2,722,000
TEXAS					
Bridgeport (IMW)	112	62	53	100	386,400
Canyon (FMR)	87	97	81	86	385,600
International Amistad (FIMPW)	65	94	82	71	3,497,000
International Falcon (FIMPW)	51	84	68	47	2,668,000
Livingston (IMW)	101	100	91	106	1,788,000
Possum Kingdom (IMPRW)	98	67	93	94	570,200
Red Bluff (P)	28	52	28	30	307,000
Toledo Bend (P)	96	95	90	91	4,472,000
Twin Buttes (FIM)	47	74	35	48	177,800
Lake Kemp (IMW)	123	60	84	100	268,000
Lake Meredith (FMW)	44	39	35	39	796,900
Lake Travis (FIMPRW)	68	80	81	68	1,144,000
MONTANA					
Canyon Ferry (FIMPR)	70	64	73	66	2,043,000
Fort Peck (FPR)	60	66	82	59	18,910,000
Hungry Horse (FIPR)	66	44	56	62	3,451,000
WASHINGTON					
Ross (PR)	35	23	27	21	1,052,000
Franklin D. Roosevelt Lake (IP)	62	34	46	72	5,022,000
Lake Chelan (PR)	52	37	38	35	676,100
Lake Cushman (PR)	28	71	87	23	359,500
Lake Merwin (P)	103	100	100	97	245,600
IDAHO					
Boise River (4 Reservoirs) (FIP)	62	70	71	54	1,235,000
Coeur d'Alene Lake (P)	115	149	123	67	238,500
Pend Oreille Lake (FP)	62	44	56	40	1,561,000
IDAHO-WYOMING					
Upper Snake River (8 Reservoirs) (MP)	63	71	74	50	4,401,000
WYOMING					
Boysen (FIP)	69	63	60	69	802,000
Buffalo Bill (IP)	58	47	60	54	421,300
Keyhole (F)	26	30	46	25	193,800
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	43	59	56	41	3,056,000
COLORADO					
John Martin (FIR)	18	26	21	19	364,400
Taylor Park (IR)	63	58	54	62	106,200
Colorado-Big Thompson Project (I)	38	65	59	37	730,300
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	71	82	...	71	31,620,000
UTAH-IDAHO					
Bear Lake (IPR)	53	63	64	52	1,421,000
CALIFORNIA					
Folsom (FIP)	50	94	74	48	1,000,000
Hetch Hetchy (MP)	36	63	39	25	360,400
Isabella (FIR)	14	27	35	13	568,100
Pine Flat (FI)	14	29	61	10	1,001,000
Clair Engle Lake (Lewiston) (P)	58	75	86	58	2,438,000
Lake Almanor (P)	79	84	61	76	1,036,000
Lake Berryessa (FIMW)	51	62	88	62	1,600,000
Millerton Lake (FI)	55	69	66	48	503,200
Shasta Lake (FIPR)	59	85	90	61	4,377,000
CALIFORNIA-NEVADA					
Lake Tahoe (IPR)	9	20	59	0	744,600
NEVADA					
Rye Patch (I)	19	28	69	17	194,300
ARIZONA-NEVADA					
Lake Mead and Lake Mohave (FIMP)	83	86	69	82	27,970,000
ARIZONA					
San Carlos (IP)	5	38	31	5	935,100
Salt and Verde River System (IMPR)	49	78	57	50	2,019,100
NEW MEXICO					
Conchas (FIR)	66	75	81	68	315,700
Elephant Butte and Caballo (FIPR)	74	87	41	76	2,233,300

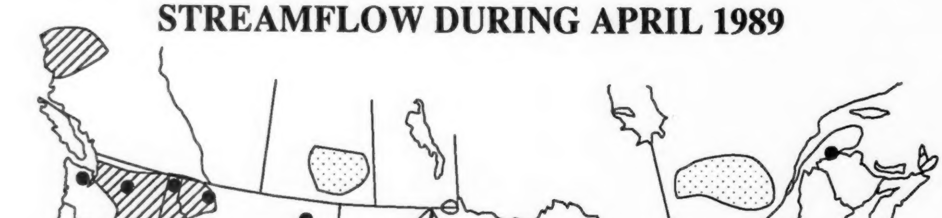
[a]1 acre-foot = 0.04356 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second per day.

[b]Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

STREAMFLOW DURING APRIL 1990

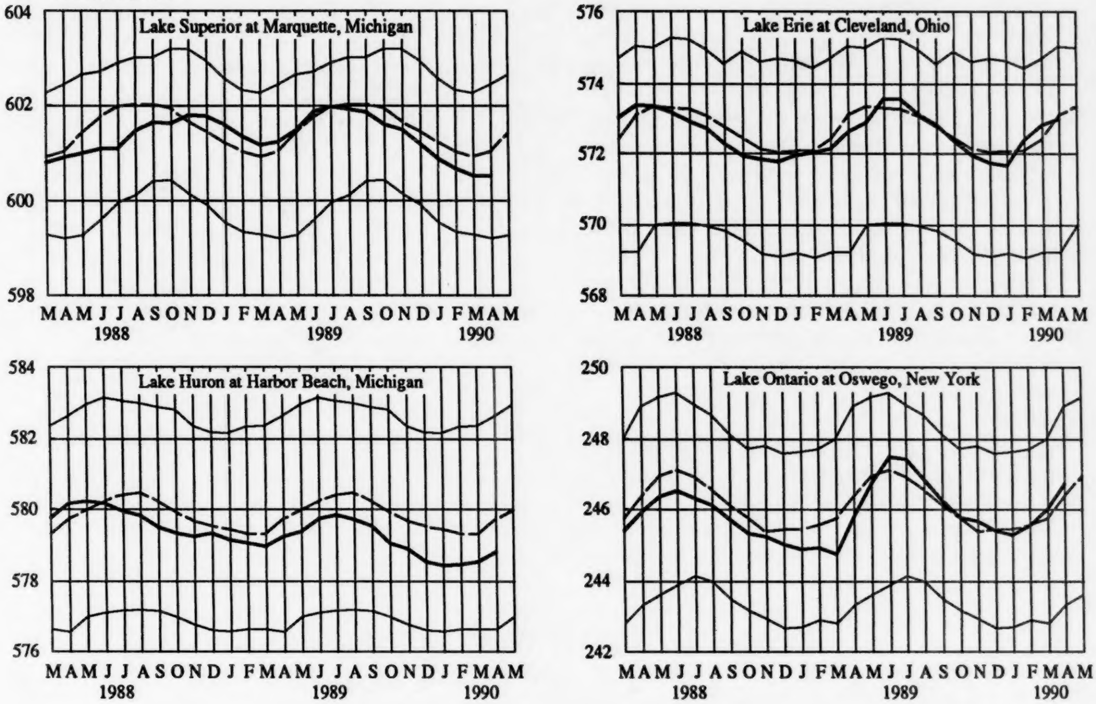


STREAMFLOW DURING APRIL 1989



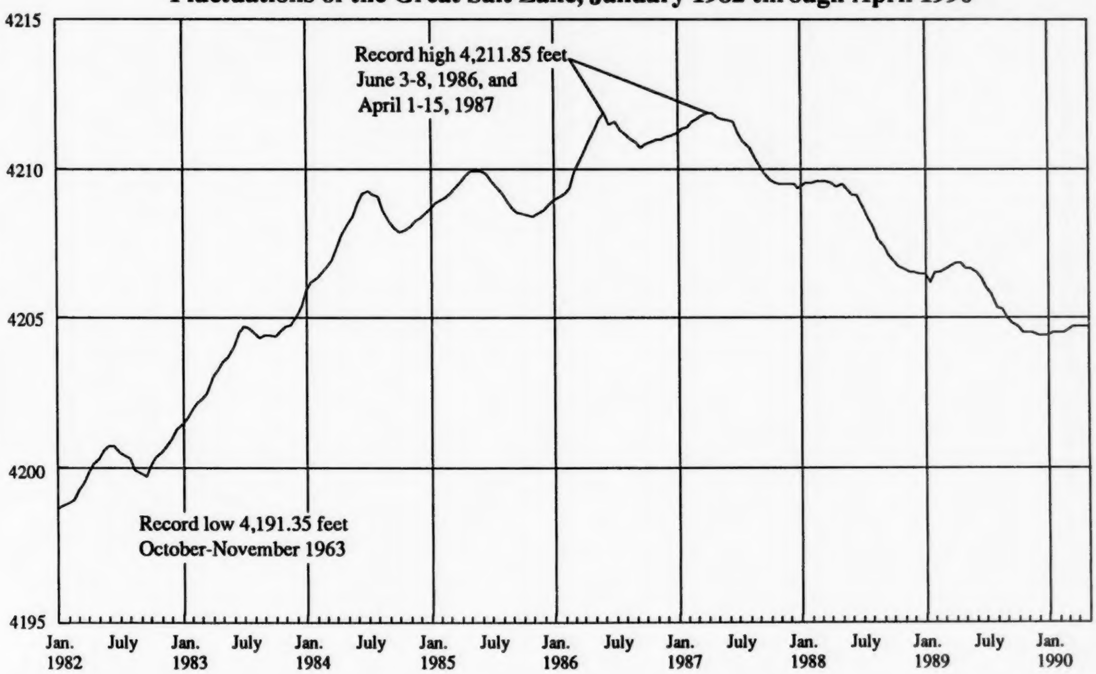
GREAT LAKES ELEVATIONS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates median of monthly values for reference period, 1951-80. Heavy line indicates mean for current period. Data from National Ocean Service.



ELEVATION, IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM OF 1929

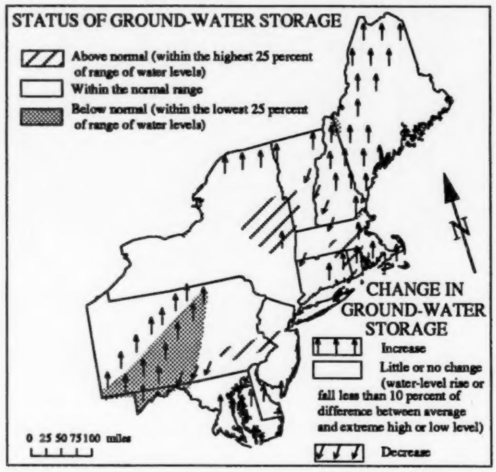
Fluctuations of the Great Salt Lake, January 1982 through April 1990



GROUND-WATER CONDITIONS DURING APRIL 1990

Ground-water levels rose in central New England, southwest and central Pennsylvania and western Maryland, in a band across Maryland, Delaware, and New Jersey and in small areas in New York and upper Vermont. (See map.) Levels declined in scattered areas in western New England and south-central Pennsylvania. Above-average water levels occurred in east-central New York, southeastern New England and southeastern Pennsylvania and central New Jersey. Trends reversed from last month to below-average levels in southwestern and central Pennsylvania and western Maryland. Below-average levels also occurred in a small area in northeastern New Hampshire and west-central Maine.

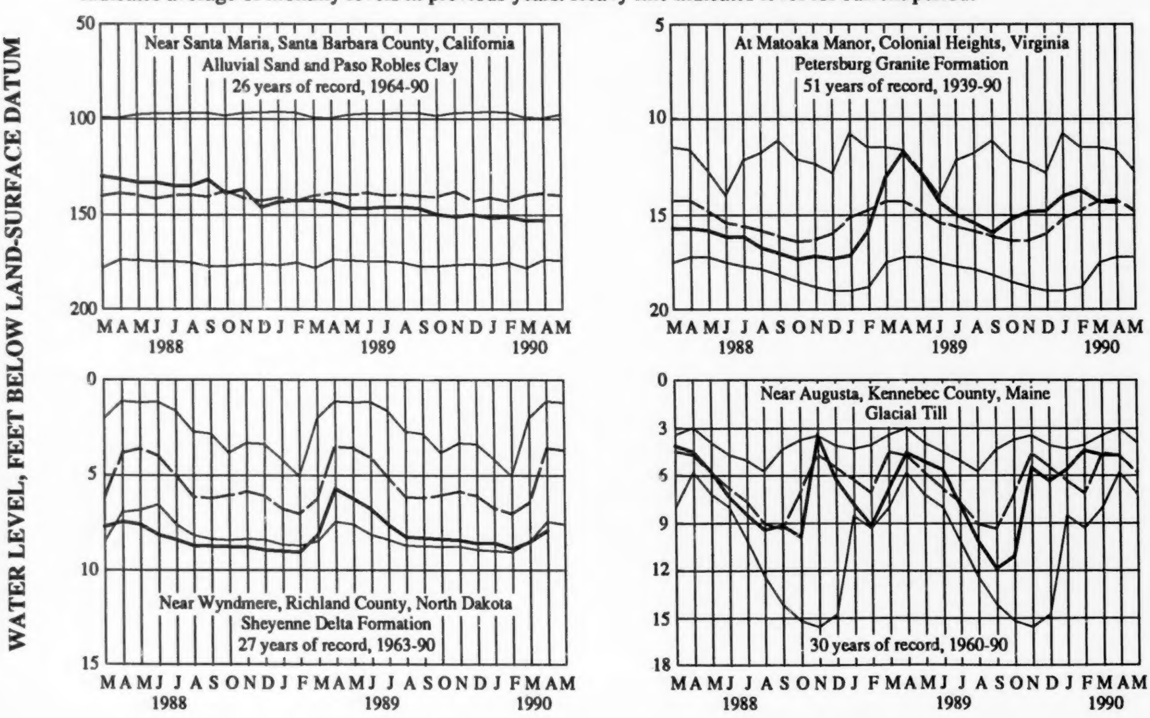
In the Southeastern States, ground-water levels rose in Kentucky and Arkansas, fell in North Carolina, and were mixed elsewhere with respect to last month's levels. Levels were above long-term averages in Kentucky and most of Virginia, below long-term averages in Arkansas, Louisiana, and most of Florida except for the panhandle. Elsewhere levels were mixed with respect to average. Water levels rose to monthly record highs in key wells at Glenville, Gilmer County, West Virginia and Viola, Graves County, Kentucky and declined to record lows in Ruston, in northern Louisiana,



Map showing ground-water storage near end of April and change in ground-water storage from end of March to end of April.

MONTHEND GROUND-WATER LEVELS IN KEY WELLS

Area between light-weight solid lines indicates range between highest and lowest record for the month. Dashed line indicates average of monthly levels in previous years. Heavy line indicates level for current period.



and on Cockspur Island, near Savannah, Georgia.

(***Water level in the key well at Colonial Heights, Virginia, was not a monthly high for March as cited in last month's writeup.***)

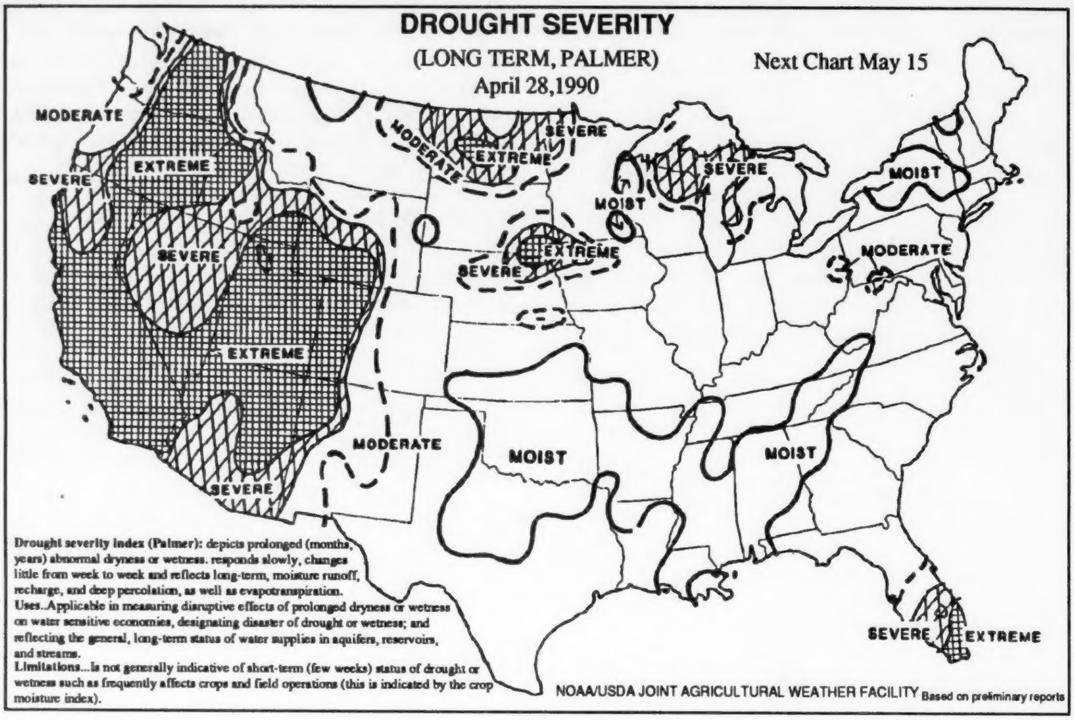
In the central and western Great Lakes States, ground-water levels rose in Wisconsin and Ohio and fell in most of Minnesota and Iowa. Levels were mixed with respect to last month in Michigan. Levels were below long-term averages in most areas, including Minnesota, Wisconsin, Ohio and Iowa, and mixed with respect to average in Michigan.

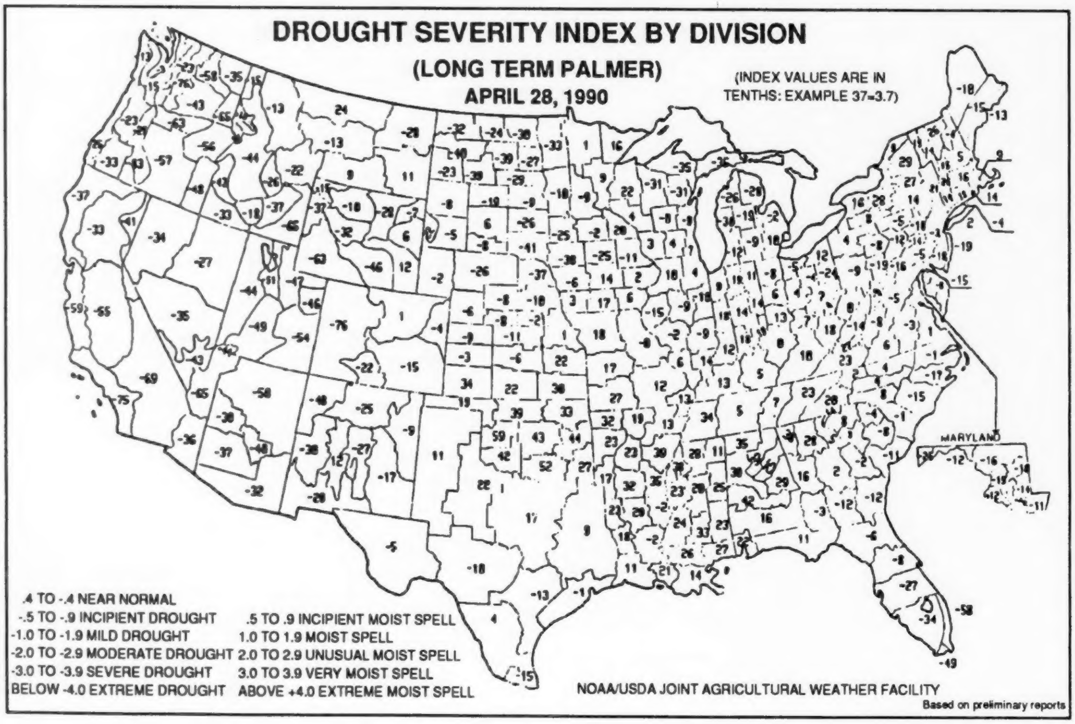
In the Western States, ground-water levels rose in Washington, North Dakota, and southern California, fell in New Mexico and elsewhere were mixed with respect to last month. Levels were above long-term averages in Washington and below average in North Dakota, Nebraska, southern California, Kansas, Arizona and Texas and most of New Mexico. Levels were mixed with respect to long-term averages in Idaho, Nevada and Utah. Despite a decline in level since last month, a record high occurred in the key well in Berrendo-Smith, New Mexico. Water levels declined to record lows at key wells in Rupert, Idaho; Las Vegas, Nevada; Halstead, Colby, and Valley Center, Kansas; and El Paso, Texas. In spite of net rises in levels since last month, record lows also occurred in Wyndmere and Dickinson, North Dakota, and Holladay, Utah. Water levels in the Logan well, Utah, remained at last month's level and tied last year's record low.

Provisional data; subject to revision

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES--APRIL 1990

Aquifer and Location	Water level in feet with reference to land-surface datum	Departure from average in feet	Net change in water level in feet since: Last month	Last year	Year records began	Remarks
Glacial drift at Hanska, south-central Minnesota	-13.57	-7.99	+2.73	-3.07	1942	
Glacial drift at Roscommon in north-central part of Lower Peninsula, Michigan.	-4.46	-0.65	-0.05	-0.84	1935	
Glacial drift at Marion, Iowa	-4.11	-0.81	-0.13	-0.61	1941	
Glacial drift at Princeton in northwestern Illinois.....	-5.90	+1.90	-0.50	+1.75	1943	
Petersburg Granite, southeastern Piedmont near Fall Zone, Colonial Heights, Virginia.	-14.36	-0.16	-0.07	-2.68	1939	
Glacial outwash sand and gravel, Louisville, Kentucky (U.S. well no. 2).	-18.67	+5.87	+0.20	+0.68	1946	
500-foot sand aquifer near Memphis, Tennessee (U.S. well no. 2).	-106.16	-16.08	-0.27	+0.14	1941	
Weathered granite, Mocksville area, Davie County, western Piedmont, North Carolina.	-14.74	+4.17	-0.24	+1.51	1932	
Sparta Sand in Pine Bluff industrial area, Arkansas ..	-237.80	-28.75	+1.10	+3.45	1958	
Eutaw Formation in the City of Montgomery, Alabama (U.S. well no. 4).	-21.7	-2.3	-1.7	+4.3	1952	
Upper Floridan aquifer on Cockspur Island, Savannah area, Georgia (U.S. well no. 6).	-35.87	-9.30	-2.77	-1.71	1956	Apr. low
Sand and gravel in Puget Trough, Tacoma, Washington.	-102.88	+2.91	+0.40	-0.15	1952	
Pleistocene glacial outwash gravel, North Pole, northern Idaho (U.S. well no. 3).	-466.2	-4.6	+0.8	+4.3	1929	
Snake River Group: Snake River Plain Aquifer, at Eden, Idaho (U.S. well no. 4).	-128.1	-5.9	+0.6	0	1957	
Alluvial valley fill in Flowell area, Millard County, Utah (U.S. well no. 9).	-34.12	-2.96	-7.53	+5.77	1929	
Alluvial sand and gravel, Platte River Valley, Ashland, Nebraska (U.S. well no. 6).	-6.13	-2.32	-0.03	-0.55	1935	
Alluvial valley fill in Steptoe Valley, Nevada	-6.75	+5.14	+0.03	-0.24	1950	
Pleistocene terrace deposits in Kansas River valley, at Lawrence, northeastern Kansas.	-22.96	-2.29	+0.14	+0.74	1953	
Alluvium and Paso Robles clay, sand, and gravel, Santa Maria Valley, California.	-153.00	-14.26	+0.10	-9.67	1957	
Valley fill, Elfrida area, Douglas, Arizona (U.S. well no. 15).	-99.92	-17.84	-1.02	-0.12	1951	
Hueco bolson, El Paso area, Texas	-270.99	-20.66	-1.03	-0.75	1965	Apr. low
Evangeline aquifer, Houston area, Texas	-300.92	-4.48	+0.87	+1.06	1965	





(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

THE DROUGHT SEVERITY INDEX
(LONG-TERM PALMER)

The Drought Severity, or Palmer, Index is an index of meteorological drought (or moisture excess) and indicates prolonged abnormal conditions affecting water-sensitive economies. The index ranges from about -6 to +6, with negative values denoting dry spells and positive values denoting wet spells. Categories of values are given under the accompanying map. The equations for the index were derived from monthly average data and based on the concept of a balance between moisture supply and demand (Palmer, 1965). The equations have been modified to compute the index on a weekly basis for publication in the Bulletin. Input data consist of weekly temperature averages and precipitation totals for 344 climatic divisions in the United States.

The index is a sum of the current moisture anomaly and a portion of the previous index to include the effect of the duration of the drought or wet spell. The moisture anomaly is the product of a climatic weighting factor and the moisture departure. The weighting factor allows the index to have a reasonably comparable significance for different locations and time of year. An index value for a division in Florida would have the same local implication as a similar value in a more arid division in western Kansas. The moisture departure is the difference of water supply and demand. Supply is precipitation and stored soil moisture, and demand is the potential evapotranspiration, the amount needed to recharge the soil, and runoff needed to keep the rivers, lakes, and reservoirs at a normal level. The runoff and soil recharge and loss are computed by keeping a hydrologic accounting of moisture storage in two soil layers. The surface layer can store 1 inch, while the available capacity in the underlying layer depends on the soil characteristics of the division being measured. Potential evapotranspiration is derived from Thornthwaite's method 1948).

The index, as formulated by Palmer, is calculated from the start of a "wet" or "dry" spell and is ambiguous until a spell is established. Once a weather spell is determined (by computing a 100 percent "probability" that an opposite spell has ended) a value is assigned. For example, the first substantial rain, for an area experiencing a prolonged drought, could signify the beginning of a wet spell or might only be a brief respite in the midst of the drought. This is not necessarily determined until months (or even years) later when enough subsequent precipitation has been accumulated to end the drought according to Palmer's definition (i.e., the probability reaches 100 percent). During this time of uncertainty both an X1 term for an incipient wet spell) and an X3 term (for an established drought) are computed. If the probability that the drought is over becomes 100 percent, then the positive X1 value is assigned to the index. If, on the other hand, the probability returns to zero, the negative X3 term is assigned and the drought continues. Conversely, a negative X2 term is computed for the opposite situation when dry weather returns to a region receiving abundant rainfall. To make the program have a real-time significance, a value is assigned based on the sum of the wet and dry terms after they have been weighted by their probabilities. This allows for a smooth transition between weather spells and makes the index continuous. During transition periods the preliminary index would not be the same as the final value defined by Palmer, but would be the same during established weather spells (i.e., when the probability is 0 or 100 percent).

A detailed explanation and examination of the index is given by Alley (1984). Both Alley and Karl (1983) address the sensitivity of the index and list some limitations.

A parameter derived from the calculations of the Drought Severity Index is the additional precipitation in inches needed to bring the index to near zero. This parameter is computed for all values of the current week' s index less than -0.5 (the upper limit of an incipient drought) and left blank for all values greater than or equal to -0.5. The precipitation values are theoretically the additional amounts required to end the drought defined by the index in each climatic division. In using this parameter to make projections, it must be realized that these values are instantaneous, valid only for the current week. To end drought in a given climatic division for the oncoming week, the precipitation amount listed plus near-normal rainfall must occur.

References

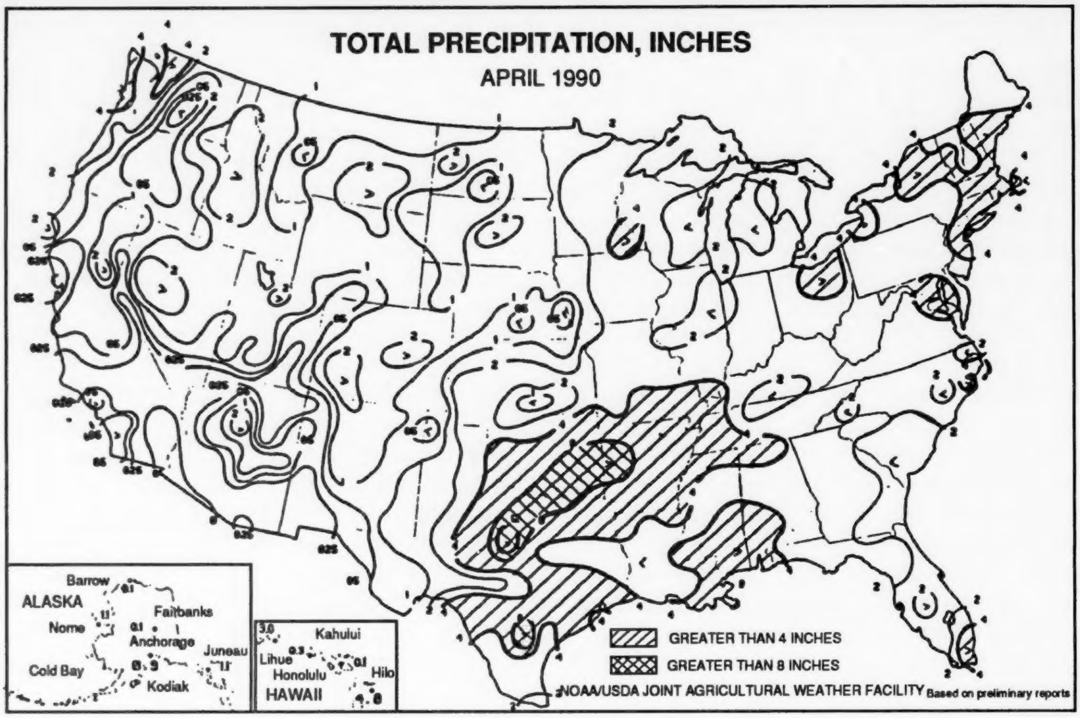
Alley, W. 1984: "The Palmer Drought Severity Index: Limitations and Assumptions," Journal of Climate and Applied Meteorology, Vol. 23, pp. 1100-1109.

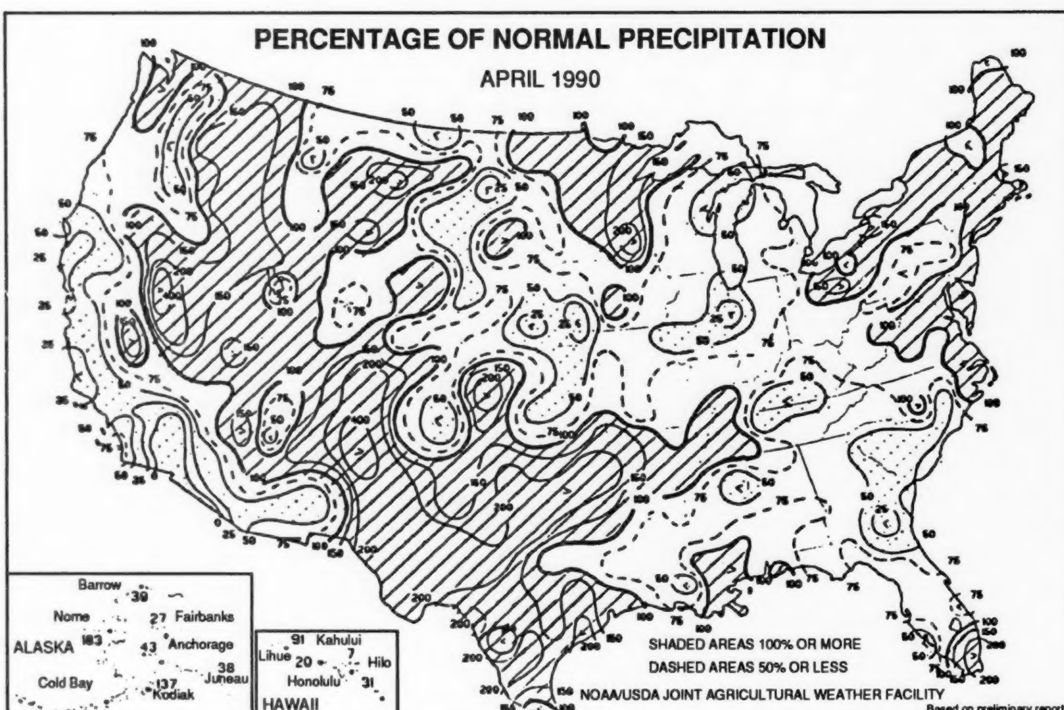
Karl, T.R. 1983: "Some Spatial Characteristics of Drought Duration in the United States," Journal of Climate and Applied Meteorology, Vol. 22, pp. 1356-1366 .

Palmer, W.C. 1965: Meteorological Drought, Weather Bureau Research Paper No. 45, U. 5 . Dept . of Commerce, 58pp.

Thornthwaite, C.W. 1948: "An Approach Toward a Rational Classification of Climate, in Geographical Review, Vol. 38 pp. 55-94.

(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)



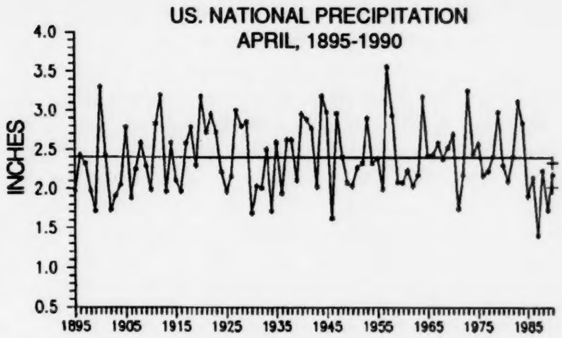


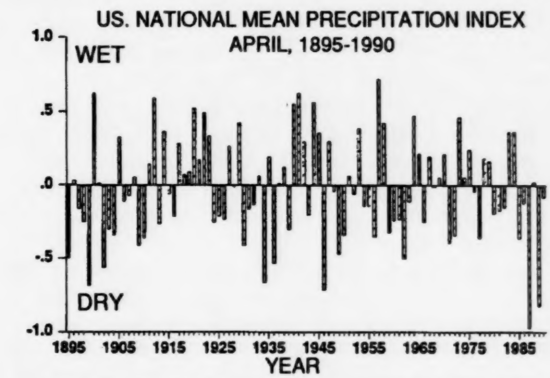
(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

APRIL WEATHER SUMMARY

A series of storm systems developed over **the country's midsection,** then rapidly intensified as they moved eastward. These storms gave abundant rainfall to the **southern Plains** and across the **northern Delta.** Toward the end of the month, a stagnant weather pattern dampened **the Plains and Mississippi Valley** with beneficial rain, but locally torrential amounts inundated portions of **north-central Texas** with amounts of over 16 inches. Parts of the **central and northern Plains** and **Pacific coast** remained dry. Most of the **Corn Belt** and **Southeast** also received less than their normal rainfall for the month. Above-normal rainfalls, however, did relieve extreme drought in **southern Florida.** Unseasonably warm conditions continued to prevail over the **western third of the Nation,** but much of the **Ohio and middle Mississippi Valleys and central and southern Plains** experienced cool weather for much of the month.

(From *Weekly Weather and Crop Bulletin* prepared and published by the NOAA/USDA Joint Agricultural Facility)

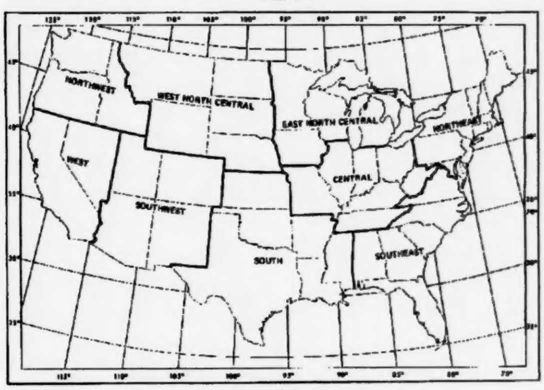




PRECIPITATION IN HISTORICAL PERSPECTIVE

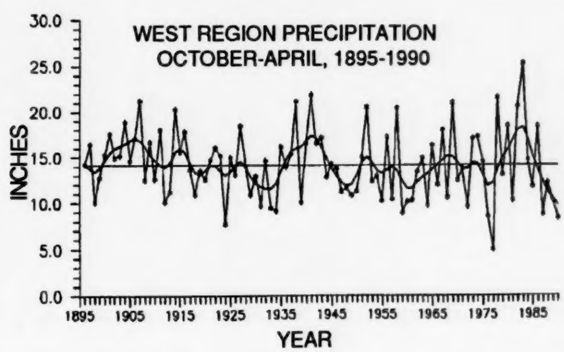
Areally-averaged precipitation (**U.S. NATIONAL PRECIPITATION**) for the nation was below the long-term mean, ranking April 1990 as the 35th driest April on record. The preliminary value for precipitation is estimated to be accurate to within 0.16 inches and the confidence interval is plotted as a '+'. Of interest is the fact that the last six years have had drier than normal Aprils.

Historical precipitation is shown in a different way in **U.S. MEAN PRECIPITATION INDEX.** The April precipitation for each climate division in the country was first standardized using the gamma distribution over the 1951-80 period. These gamma-standardized values were then weighted by area and averaged to determine a national standardized precipitation value. Negative values are dry, positive are wet. This index gives a more accurate indication of how precipitation across the country compares to the local normal climate. The areally-weighted mean standardized national precipitation ranks April 1990 as the 45th driest April on record. It is interesting to note that the two driest Aprils on record, as measured by this index, occurred in the last four years (1987 driest, 1989 second driest).



The precipitation ended the long-term drought in southern Texas. However, over a fourth of the country continued in the severe to extreme long-term drought categories. Only nine other Aprils have had a greater drought area. Meanwhile, about seven percent of the nation was in the severely to extremely moist categories. The size of the wet area has been steadily decreasing over the last three months.

In contrast to the wetness of the southern and central states, the West region (California and Nevada) has had an unusually dry rainy season. October-April 1989-90 ranks as the third driest such period on record (**WEST REGION PRECIPITATION**). The last four years have had very dry October-April periods, with the long-term filtered curve reaching alarmingly low levels.



(From *UNITED STATES APRIL CLIMATE IN HISTORICAL PERSPECTIVE,* Climate Perspectives Branch, Global Climate Lab, NCDC, NOAA)

WATER CONDITIONS IN CALIFORNIA

The California drought is continuing to intensify. Statewide stream runoff forecasts have now fallen below 40 percent of average and surface water shortages will occur in many areas. Chances of enough precipitation occurring, this late in the season, to improve water supply conditions are extremely remote. California's Central Coast is by far the hardest hit drought area in the State. Runoff in that area has been only 20 percent of average during the past three years, and has been only 10 percent this year.

Ground water storage has continued to decline in most State basins but is still adequate to meet or supplement most agricultural and municipal needs, except in the Central Coast and a few other areas in the Central Valley and foothills. Where ground water is not available the acreage of annual crops will be reduced resulting in a very substantial economic loss.

In the Sacramento Valley ground water levels have generally dropped a few feet since 1986, the last wet year, but most water tables can be reached at 10 to 30 feet below ground level.

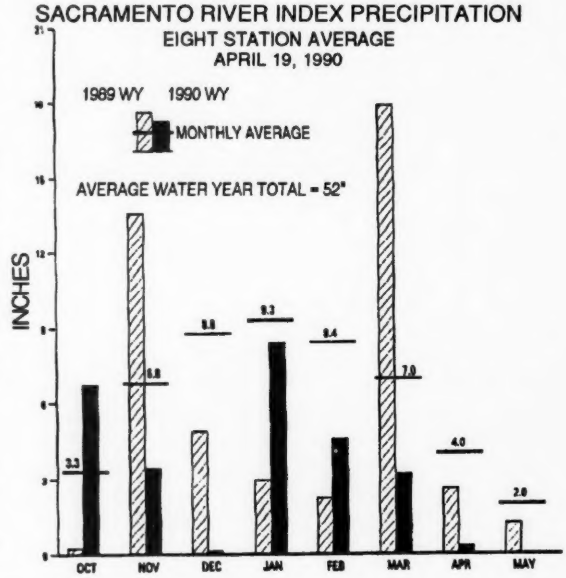
In the San Joaquin Valley and in much of Southern California the ground water level has dropped 10 to 20 feet since 1986 and most water levels are 100 to 200 feet deep. Long-term overdraft in the San Joaquin Valley averages about 1.3 million acre feet each year but has been much greater since 1986. Where ground water is available this year in the San Joaquin Valley, the amount of ground water that is extracted may exceed the amount that was extracted during the 1976-77 drought. Southern California weathered the first 3 drought years fairly easily, but reduced Colorado River and Owens Valley deliveries will result in shortened supplies to many Southern California communities this year.

Again this year ground water extractions, especially in the San Joaquin basin, are expected to be unusually high. The main consequences of this extraction will be lower ground-water levels with resultant higher pumping costs, and in some cases increased ground water contamination.

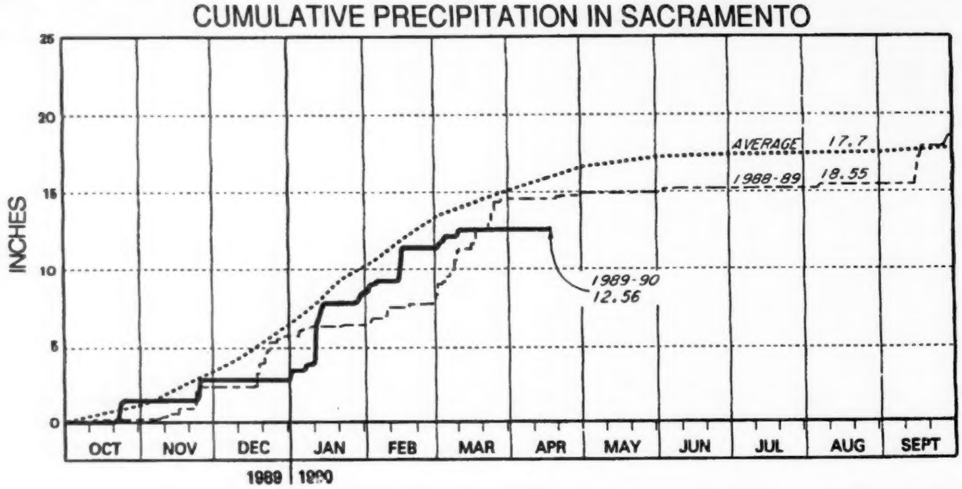
WATER OVERDRAFT 1985 LEVEL OF DEVELOPMENT
(In 1,000's of acre-feet)

Regions	Overdraft
North Coast	0
San Francisco Bay	30
Central Coast	220
South Coast	120
Sacramento River	110
San Joaquln River and Tulare Lake	1,340
North Lahontan	0
South Lahontan	150
Colorado River	50
TOTAL	2,020

SACRAMENTO RIVER INDEX PRECIPITATION

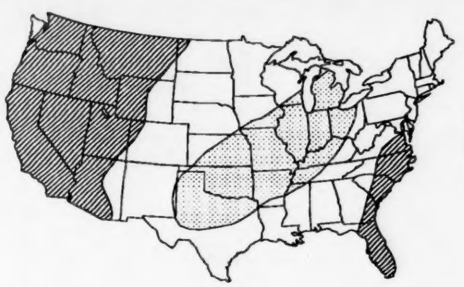


CUMULATIVE PRECIPITATION IN SACRAMENTO

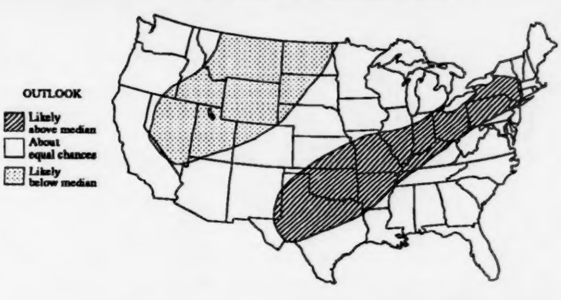


(From *California Water Supply Outlook* prepared and published by the California Department ofWater Resources)

TEMPERATURE OUTLOOK FOR MAY-JULY 1990



PRECIPITATION OUTLOOK FOR MAY-JULY 1990



NATIONAL WATER CONDITIONS

APRIL 1990

Based on reports from the Canadian and U.S. Field offices; completed May 21, 1990

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EXPLANATION OF DATA (Revised December 1989)

Cover map shows generalized pattern of streamflow for the month based on provisional data from 186 index gaging stations—18 in Canada, 166 in the United States, and 2 in the Commonwealth of Puerto Rico. Alaska, Hawaii, and Puerto Rico inset maps show streamflow only at the index gaging stations that are located near the point shown by the arrows. Classifications on map are based on comparison of streamflow for the current month at each index station with the flow for the same month in the 30-year reference period, 1951-80. Shorter reference periods are used for one Canadian index station, two Kansas index stations, and the Puerto Rico index stations because of the limited records available.

The ***streamflow ranges map*** shows where streamflow has persisted in the above- or below-normal range from last month to this month and also where streamflow is in the above- or below-normal range this month after being in a different range last month. Three ***pie charts*** show: the percent of stations reporting discharges in each flow range for both the conterminous United States and southern Canada, and also the percent of area in each flow range for the conterminous United States and southern Canada. The ***bar graph*** shows total mean and total median flow for all reporting stations in the conterminous United States and southern Canada.

The comparative data are obtained by ranking the 30 flows for each month of the reference period in order of decreasing magnitude—the highest flow is given a ranking of 1 and the lowest flow is given a ranking of 30. Quartiles (25-percent points) are computed by averaging the 7th and 8th highest flows (upper quartile), 15th and 16th highest flows (middle quartile and median), and the 23rd and 24th highest flows (lower quartile). The upper and lower quartiles set off the highest 25 percent of flows and lowest 25 percent of flows, respectively, for the reference period. The median (middle quartile) is the middle value by definition. For the reference period, 50 percent of the flows are greater than the median, 50 percent are less than the median, 50 percent are between the upper and lower quartiles (in the normal range), 25 percent are greater than the upper quartile (above normal), and 25 percent are less than the lower quartile (below normal). Flow for the current month is then classified as: in the ***above-normal range*** if it is greater than the upper quartile, in the ***normal range*** if it is between the upper and lower quartiles, and in the ***below-normal range*** if it is less than the lower quartile. Change in flow from the previous month to the current month is classified as ***seasonal*** if the change is in the same direction as the change in the median. If the change is in the opposite direction of the change in the median, the change is classified as ***contraseasonal*** (opposite to the seasonal change). For example: at a particular index station, the January median is greater than the December median; if flow for the current January increased from December (the previous month), the increase is seasonal; if flow for the current January decreased from December, the decrease is contraseasonal.

Flood frequency analyses define the relation of flood peak magnitude to probability of occurrence or recurrence interval. ***Probability of occurrence*** is the chance that a given flood magnitude will be exceeded in any one year. ***Recurrence interval*** is the reciprocal of probability of occurrence and is the average number of years between occurrences. For example, a flood having a probability of occurrence of 0.01 (1 percent) has a recurrence interval of 100 years. ***Recurrence intervals imply no regularity of occurrence***; a 100-year flood might be exceeded in consecutive years or it might not be exceeded in a 100-year period.

Statements about ***ground-water levels*** refer to conditions near the end of the month. The water level in each key observation well is compared with average level for the end of the month determined from the 30-year reference period, 1951-80, or from the entire past record for that well when only limited records are available. Comparative data for ground-water levels are obtained in the same manner as comparative data for streamflow. ***Changes in ground-water levels***, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data are given for five stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). ***Dissolved solids*** are minerals dissolved in water and usually consist predominately of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. ***Dissolved-solids discharge*** represents the total daily amount of dissolved minerals carried by the stream. ***Dissolved-solids concentrations*** are generally higher during periods of low streamflow, but the highest dissolved-solids discharges occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at times of low flow.

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